MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XLII. NOVEMBER 11, 1881. No. 1.

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On a simple and practicable Method of Measuring the Relative Apparent Brightnesses or Magnitudes of the Stars with considerable Accuracy. By Professor Pritchard.

Circumstances not generally interesting here to detail have recently diverted my attention from other astronomical work to what is conventionally meant by the magnitudes of the stars. It may be sufficient here to say that, having just completed the reduction of the relative coordinates of 250 stars in the cluster 39 Messier in the constellation *Cygnus*, for comparison by other astronomers at some remotely future period, I felt that perhaps only one-half of the work was done, unless some reliable measures of the relative magnitudes of the stars could be secured. Prof. Pickering's most interesting researches into the results obtainable from accuracy in star magnitudes also weighed on my mind. On consulting the various authorities on the subject, I found the question, whether of result or of method, somewhat in a chaos, so far as any considerable degree of accuracy was concerned. Even Struve, for instance, with all his care, gives on some occasions not less than three different magnitudes for the same star.

In this perplexity, I applied myself to the attempt of devising some method, which might land me in greater certainty, and after some time I hit upon a method which, after applying it to sixty stars, promises certainty, to the extent of one-tenth of a magnitude, in all the stars yet examined, from *α Lyræ* to the stars of least brightness estimated by Argelander in the "Durch-

B

musterung." I offer this contribution, in an important and hitherto obscure branch of astronomy, to the scrutiny of persons competent to form an opinion.

So soon, however, as I had devised the method, it at once occurred to me that it was so simple that it must have been employed by other astronomers besides myself. Accordingly, I found that our old associate Mr. Dawes, whose memory is so greatly respected among us, did employ each of the means separately, by the combination of which I believe I have succeeded. My method, however, of applying and discussing these means will be found to be widely and generically different in principle from his, and especially because he has assumed as the basis of all his results, that a star observed to be only just visible in a telescope of which the diameter of the object glass is 0·15 inch, is of a certain definite and uniform magnitude—viz. the sixth; whereas, I have found, and I am sure other astronomers will find, that there is no constancy in the aperture at which any single star is just visible. The result of observations recently made in this Observatory, as will be seen in the results recorded in the present communication, is that on two different nights, when no differences of meteorological circumstances of the atmosphere were apparent, the same star shone with brilliancies differing by nearly a whole magnitude. Moreover, the effect of a difference of Zenith Distances from 52° to 74° on the same night, was found to affect the apparent brightness by six-tenths of a magnitude.

In referring thus to the methods employed by Mr. Dawes, I cannot pass over the still more ingenious device of Mr. Knobel (see *Monthly Notices*, Dec. 1874, and June 1875), who, by means of a glass mirror, in its two conditions of silvered and unsilvered, effected the same sort of results as those derived from my use of a glass wedge. Had Mr. Knobel seen fit to persevere to the end in forming a complete catalogue of star magnitudes, my own present efforts would have been assisted or modified. Still, it would have been interesting and valuable, if he had more fully recorded the resulting differences of the several individual determinations of the brightness of the same star, in order that the unavoidable errors arising from this (or any other) method might be distinctly seen. In what follows, I have for the most part endeavoured to give these details, my object being to discuss one method of observation, without forming any judgment as to other methods possibly quite as good.

Similar remarks apply to the memorable efforts detailed by Sir John Herschel in the Cape Observations (chap. iii. p. 305). It is perhaps needless to say that they bear the marks of his genius and sagacious perseverance, and cannot properly be disregarded in any stellar photometric researches.

The very successful efforts also of Messrs. Knott and Baxendell, printed so far back as 1863, show what can be done by eye-observations; but as they were not instrumentally photometric,

they scarcely fall within the species of methods discussed in this communication.

I will now detail my method of proceeding, and give the results of its application. A wedge of the purest and most homogeneous neutral-tinted glass that could be procured was carefully constructed for me by Mr. Grubb, of Dublin. It is about six inches long, and its greatest thickness one-tenth of an inch. To it is cemented another similar wedge of clear glass reversed, the whole forming a rectangular parallelopipedon. This wedge was provisionally divided, in its cell, to tenths of inches, and was made to slide close to the achromatic lens which formed the eyepiece of an excellent telescope of four inches aperture, attached to the tube of the large Equatoreal of this Observatory. Close on to this wedge, and immediately over the centre of the eye lens, projects a diaphragm, circularly perforated to direct the eye. Of course there is nothing new in this contrivance; its value depends on the mode of using it. A star, convenient for the purpose, was selected, presumed to be stable in its brightness: in this instance it was κ *Lyræ*, for which I shall assume the brightness or magnitude assigned to it by Argelander, 4·7; any other magnitude would serve the purpose perhaps equally well. This star was viewed on a fair night through the four-inch telescope, and the position of the wedge was noticed when the star was just extinguished. The mean of five readings consecutively taken was used in the further discussion. The aperture of the telescope was then reduced to two inches, and the reading of the wedge was taken as before, when the star became just invisible. It was contended that the effect of the thickness of wedge between the two readings produced the same effect as diminishing the aperture from four to two inches. This sort of observation repeated many times on different nights gives, as will be seen, an important constant, indicating the absorbing capacity of the wedge, of which constant great use is made in the following discussion. Thus if τ represent the thickness of the wedge through which the light passes, if L be the amount of the light incident, and L_1 the amount emergent, then

$$\log \frac{L}{L_{\prime}} = c\tau \text{ or } = \kappa I \qquad (1),$$

where I is the length of the interval between the two readings of the wedge, and $I = \tau \times \tan$ angle of the wedge: κ is the constant to be determined.

Inasmuch as the star (κ *Lyræ*) is observed with apertures whose diameters are as 2 : 1, it follows that here

$$\log \frac{L}{L_{\prime}} = \log 4 = \kappa I;$$

therefore

$$\kappa = \frac{\cdot 6021}{I} \qquad (2).$$

This gives (κ) as a number expressed in terms of the number of intervals marked on the scale of the wedge, between the two observations. In the case of the wedge used in these researches (see Table I.)

$$\kappa = 0{\cdot}053 \pm 0{\cdot}0010 \qquad (3),$$

and therefore in general, from (1),

$$\log \frac{L}{L_{\prime}} = 0{\cdot}053 \text{ I} \qquad (4).$$

Again, if L_n and L_{n+x} represent the relative amounts of the light in two stars reputed to be of the n^{th} and of the $(n+x)^{\text{th}}$ magnitudes—that is, differing from each other by (x) magnitudes—then by the recognised convention, proposed by Mr. Pogson, and generally accepted, we have

$$\frac{L_n}{L_{n+x}} = (2{\cdot}512)^x$$

and therefore

$$\log \frac{L_n}{L_{n+x}} = {\cdot}4 \begin{pmatrix}\text{diff. of magnitude}\\ \text{of the two stars}\end{pmatrix} \qquad (5).$$

Now, suppose that I_x be the number of wedge intervals between the two readings of the wedge, at which the lights of these two stars are respectively extinguished when viewed successively through the wedge in the eyepiece of the four-inch telescope (or any other telescope), then by (4) we have

$$\log \frac{L_n}{L_{n+x}} = {\cdot}053 \text{ I}_x,$$

i.e. by (5) $\quad 0{\cdot}4$ (diff. of magnitude) $= 0{\cdot}053 \text{ I}_x$,

or $\quad$ difference of magnitude $= 0{\cdot}133 \text{ I}_x \qquad (6).$

This expression is the fundamental theorem on which the results in this research are based. Hence it becomes apparent, that, for the particular wedge used in these researches, one interval of the wedge (*i.e.* one-tenth of an inch) indicates a difference of about one-eighth of a magnitude; and as in practice, and in the average of five readings, less than one-half of an interval is practically cognisable in effect, it follows that the method may be relied upon to about ·06 of a magnitude. It appears also that if the original division of the wedge were provisional only, it would be practicable to make the divisions of such a length that each shall be the indication of one-tenth of a magnitude.

The following is an example of the manner in which one

value of κ is obtained, and also the difference of the magnitude between that star and another (Lal. 33612) :—

1881, *October* 17.

Name of star ...	κ Lyræ		κ Lyræ		Lal. 33612	
Aperture of telescope	4 inches.		2 inches.		4 inches.	
	Wedge Reading	Deviation from Mean.	Wedge Reading.	Deviation from Mean.	Wedge Reading.	Deviation from Mean.
	div.		div.		div.	
	19·9	0·34	32·1	0·54	31·1	0·46
	20·2	0·04	31·3	0·26	30·3	0·34
	20·4	0·16	31·4	0·16	30·4	0·24
	21·0	0·76	31·9	0·34	31·4	0·76
	19·7	0·54	31·1	0·46	30·0	0·64
Mean Reading	20·24	0·37	31·56	0·35	30·64	0·49

For κ, the Difference of Mean Readings $= 31{\cdot}56 - 20{\cdot}24 = 11{\cdot}32$ div.;

therefore

by (2) ... ... $\kappa = \dfrac{0{\cdot}6021}{11{\cdot}32} = 0{\cdot}053.$

For Magnitude of Lalande 33612, the Difference of Mean Readings ... $= 30{\cdot}64 - 20{\cdot}24 = 10{\cdot}40$;

therefore

by (6) ... Diff. of Magnitude $= 10{\cdot}40 \times {\cdot}133 = 1{\cdot}38$ magnitude.

The numerical quantities given in equation (3) have been derived from the individual determinations exhibited in the following table.

Table I.

Date.	κ	Date.	κ
1881, Oct. 17	0·053	1881, Oct. 26	0·053
	·050	27	·050
18	·060		·041
	·056	29	·050
19	·060	Nov. 2	·058
	·061		·049
25	·051		

of which tabular values the mean is $\kappa = 0{\cdot}053$ with a probable error of 0·001.

From the observations made in the course of this investigation, it became apparent that on different nights κ *Lyræ*, and consequently other stars, shone with very considerable variations in brightness. For instance, on Oct. 17, the mean reading of the wedge when κ *Lyræ* was just extinguished was 20·24 divisions; on Oct. 18, 22·30 divisions; and on Oct. 26 it was 29·04

divisions—indicating an extreme difference of brightness, equivalent to one magnitude. At the same time, it is observable that the individual determinations of κ do not exhibit any such instability. This is very important. Independently of the general effect of meteorological circumstances, there was also perceptible an effect produced on the brightness of stars at different distances from the zenith, owing, no doubt, to the different thicknesses of the atmosphere through which the light necessarily passed. In order to ascertain whether it was possible to connect numerically this alteration of brightness with corresponding alterations of Zenith Distances, I constructed a table from which the ratio of the thickness of the atmosphere at any Zenith Distance (Z) to the thickness at the zenith itself could be obtained at sight. I assumed that the effect was approximately the same as that which would be produced by a homogeneous atmosphere of the height of $5\frac{1}{2}$ miles; but when I had completed it, I found that a similar table had already been constructed, and published in the "Annuaire de l'Observatoire de Montsouris," and reprinted in the "Edinburgh Observations," vol. xiv. The latter table is here subjoined; it seems to assume a height of atmosphere of 50 miles. It is perhaps curious to observe that for moderate altitudes either table may be used with equal advantage for approximate purposes.

TABLE II.

Zenith Distance.	Ratio of Thickness.	Zenith Distance.	Ratio of Thickness.	Zenith Distance.	Ratio of Thickness.
1°	1·00	31°	1·17	61°	2·02
2	1·00	32	1·18	62	2·09
3	1·00	33	1·19	63	2·15
4	1·00	34	1·20	64	2·23
5	1·01	35	1·22	65	2·30
6	1·01	36	1·23	66	2·39
7	1·01	37	1·25	67	2·48
8	1·01	38	1·26	68	2·58
9	1·02	39	1·28	69	2·68
10	1·02	40	1·30	70	2·80
11	1·02	41	1·32	71	2·93
12	1·03	42	1·34	72	3·07
13	1·03	43	1·36	73	3·22
14	1·03	44	1·38	74	3·39
15	1·04	45	1·41	75	3·58
16	1·04	46	1·43	76	3·79
17	1·05	47	1·46	77	4·02
18	1·05	48	1·49	78	4·29

Zenith Distance.	Ratio of Thickness.	Zenith Distance.	Ratio of Thickness.	Zenith Distance.	Ratio of Thickness.
19°	1·06	49°	1·51	79°	4·59
20	1·06	50	1·54	80	4·92
21	1·07	51	1·58	81	5·31
22	1·08	52	1·61	82	5·75
23	1·09	53	1·65	83	6·25
24	1·09	54	1·68	84	6·83
25	1·10	55	1·72	85	7·51
26	1·11	56	1·77	86	8·28
27	1·12	57	1·81	87	9·18
28	1·13	58	1·86	88	10·20
29	1·14	59	1·91	89	11·37
30	1·15	60	1·96	90	12·69

In order to obtain a formula for the atmospheric absorption of light at different Zenith Distances, I observe that by the notation of (1), we have, for the ratio of light incident in, and emergent from, the atmosphere

$$\log \frac{L}{L_{,}} = K \times \text{(thickness of the atmosphere traversed)}; \qquad (7)$$

consequently, if L_n and L_{n+x} represent the measures of the light of κ *Lyræ* at the Zenith Distances (Z_1 and Z_2), and τ the difference of the tabular thickness at these Zenith Distances, then

$$\log \frac{L_n}{L_{n+x}} = K\tau, \qquad (8)$$

or from (5)

$$K\tau = \cdot 4 \text{ difference of magnitude.} \qquad (9)$$

Now, on Oct. 17 κ *Lyræ* was examined with the 4-inch telescope and wedge, at the Zenith Distance 36° 52′, and the light was extinguished at a wedge-reading of 20·14. It was again observed at the Zenith Distance 70° 58′, the corresponding wedge-reading being 22·64. This indicates a difference of magnitude of 0·33, also the tabular length of the path for a Zenith Distance 36° 52′ is 1·25, and for Zenith Distance 70° 58′ it is 2·93; consequently, the tabular difference of path is 1·68. Hence from (9)

$$\cdot 4 \times \cdot 33 = K\, 1{\cdot}68$$

$$K = 0{\cdot}079,$$

and

$$\log \frac{L_n}{L_{n+x}} = 0{\cdot}079\,\tau, \qquad (10)$$

and finally by (5)

$$\left.\begin{array}{c}\text{Difference of magnitude}\\ \text{caused by atmosphere}\end{array}\right\} = 0{\cdot}198 \left\{\begin{array}{c}\text{Tabular difference}\\ \text{of thickness}\end{array}\right. \qquad (11).$$

This again is the fundamental expression for the atmospheric effects on the light of a star arising from mere alteration in its Zenith Distance, *provided the meteorological elements remain the same.* For instance, κ *Lyræ* was on the same night observed again at the Zenith Distances 48° 37′ and 60° 22′. On applying the proper quantities taken from Table II., it appears that the theoretical alterations in magnitude due to the observation at these successive Zenith Distances were respectively 0·05, 0·09, and 0·19. The actual observed differences of magnitude were 0·05, 0·18, and 0·10 respectively; the error in the latter cases amounting to about one-tenth of a magnitude—*i.e.* if the effect of alterations of Zenith Distance were not considered, there would be an error in the stars of least altitude of 0·33 magnitude; but if the correction in (11) be applied, the resulting error will be at the worst one-tenth of a magnitude; and it will be observed that in this instance K is obtained from one observation only; and moreover what is here stated is to be regarded rather as the mere indication of a method than as its completion.

In Table III. are given the values of K which have been derived from the observations made at the greatest variation of Zenith Distance, and the comparison between the observed and computed magnitudes at intermediate altitudes.

TABLE III.

Date.	Star.	Z.D.	Thickness of Air.	Observed Diff. of Mag.	Value of K	Computed Diff. of Mag.	C−O
Oct. 17	κ Lyræ	36° 52′	1·25				
		48 37	1·50	0·05	0·079	0·05	0·00
		60 22	1·99	0·18		0·09	−0·09
		70 58	2·93	0·10		0·19	+0·09
18	κ Lyræ	52 12	1·61				
		61 48	2·08	0·20	0·151	0·17	−0·03
		71 59	3·07	0·35		0·38	−0·03
19	κ Lyræ	43 4	1·36				
		55 58	1·77	0·25	0·213	0·22	−0·03
		60 0	1·96	0·07		0·10	+0·03
25	κ Lyræ	52 38	1·64				
		58 13	1·88	0·15	0·139	0·09	−0·06
		73 43	3·34	0·44		0·50	+0·06
26	κ Lyræ	48 34	1·50				
		54 17	1·69	0·07	0·180	0·09	+0·02
		62 9	2·10	0·20		0·18	−0·02

From all these remarks combined it follows that it is not admissible to connect aperture with magnitude without taking into the account the general meteorological circumstances at the time of observation, and also any considerable variations of the Zenith Distance of the stars compared; but that if the wedge-reading of extinction of the standard star be observed from time to time—say, every hour—both these sources of errors will be effectually eliminated. Moreover, from the fifty stars (given in Table IV.) already compared, it seems that it may be safely assumed that the differences of magnitude are obtainable with a far greater degree of precision than can be reached by eye-estimation. Also, from the repeated observation of several of Argelander's fainter stars, on different evenings, as well as of the bright stars α *Lyræ*, *Capella* and *Aldebaran* (given in Table V.), it seems that the deviations from mean values are less than one-tenth of a magnitude.

TABLE IV.

No.	Star's Designation.	Oxford Mag. κ Lyræ = 4·7.	Argelander Mag.	Heis Mag.	Houzeau Mag.
1	Lal. 33612	6·08	5·8	6	
2	Groomb. 2530	6·28	6·0	6	6
3	Groomb. 2533	5·96	5·5	5·6	6
4	Groomb. 2538	6·14	6 0	6	6·7
5	Lal. 34064	6·90	7·0 }	6·7	
6	Lal. 34049	7·64	7·7 }		
7	μ Lyræ	5·31	5·1	5	5
8	Lal. 34132	6·08	6·1	6·5	
9	W. B. 18h No. 794	5·86	5·5	6·5	6
10	W. B. 18h No. 894	5·95	6·4	6	6·7
11	W. B. 18h No. 934	5·68	5·8	6	6
12	α Lyræ	0·53	1	1	1
13	W. B. 18h No. 972	6·30	7·0	6·7	
14	Radcliffe 3995	6·53	6·0	6·7	
15	Piazzi 18h No. 153	6·24	6·5	6·7	
16	W. B. 18h No. 1038	6·65	6·3	6·7	
17	Groomb. 2627	6·27	6·2	6·7	
18	W. B. 18h No. 1117	6·47	7·0	6·7	6·7
19	Lalande 34853	5·79	5·5	6	6
20	Piazzi 18h No. 172	6·21	6·4	6·7	
21	ε Lyræ	4·29	4·3	4·5	4
22	5 Lyræ	4·61	4·6	5·4	4
23	ζ² Lyræ	5·46	5·5 }	4·5	4
24	ζ¹ Lyræ	4·50	4·5 }		

No.	Star's Designation.	Oxford Mag. κ Lyræ = 4·7.	Argelander Mag.	Heis Mag.	Houzeau Mag.
25	W. B. 18h No. 1218	5·07	4·9	5	
26	Groomb. 2664	5·77	6·0	6	6·7
27	Lalande 35045	6·07	6·0	6	
28	ν Lyræ	5·45	5·5	6·5	6
29	W. B. 18h No. 1402	6·61	6·5	6·7	6·7
30	W. B. 18h No. 1460	5·90	6·5	6	
31	W. B. 18h No. 1489	5·84	6·2	6·7	6
32	δ¹ Lyræ	6·06	6·1	6	
33	δ² Lyræ	4·54	4·5	4·5	3·4
34	Bradley 2381	6·37	7·0	6·7	
35	Lal. 35405	7·07	7·5 }	6·7	
36	Lal. 35407	7·56	8·2 }		
37	Bradley 2388	5·51	6·7	6	6·7
38	W. B. 18h 1641	5·98	6·2	6·5	6
39	γ Lyræ	3·18	3·2	3·4	3
40	W. B. 18h 1670	5·74	5·8	6	5·6
41	Groomb. 2727	6·01	6·9	6	
42	Groomb. 2728	5·45	6·2	6	6·7
43	W. B. 19h No. 20	6·06	6·3	6	6
44	17 Lyræ	5·42	6·0	6·5	6
45	ι Lyræ	4·90	5·2	5	5
46	Lal. 35922	6·38	6·5 }	6	
47	Lal. 35978	6·31	6·5 }		
48	Arg. + 26° No. 3474	6·48	7·4		
49	W. B. 19h No. 159	6·60	7·5 }	6	
50	W. B. 19h No. 165	6·67	7·7 }		

Notes.

No. 12. The magnitude given is the mean of four separate determinations: viz. 0·36, 0·65, 0·56 and 0·56.

No. 21. The magnitude is the mean of three separate determinations, the two components being treated as one star. The individual values are 4·20, 4·27 and 4·40.

No. 39. Three separate determinations gave the magnitude as 3·10, 3·13 and 3·31. The mean is here given.

The agreement is greater with Argelander, than with Heis or Houzeau.

TABLE V.

Name of Star.		Obs. Mag.	Obs. Mag.	Obs. Mag.	Obs. Mag.	Mean Mag.	Argelander's Mag.	Average Deviation from Mean.
α Lyræ		0·36	0·65	0·56	0·56	0·53		0·09
Capella		0·47	0·42	0·60		0·50		0·07
Aldebaran		0·88	0·86	0·93		0·90		0·03
Arg. + 36° No.	3091	8·36	8·43	8·51		8·43	8·8	0·05
+ 36	3103	9·14	9·37			9·25	9·5	0·11
+ 36	3092	8·47	8·55	8·60		8·54	9·0	0·05
+ 36	3101	7·43	7·47	7·29		7·40	7·2	0·07
+ 36	3102	9·03	8·99			9·01	9·2	0·02
+ 36	3104	7·48	7·47	7·40		7·45	7·3	0·03
+ 36	3167	7·95	8·17	7·90		8·01	7·7	0·11
+ 36	3079	7·79		7·93		7·86	8·1	0·07

After the reading of the above communication to the Society, there ensued a long and interesting discussion by the Fellows present who had directed their attention to the subject.

Some doubts were expressed as to the facility, or even possibility, of the measurement of the magnitude being repeated (by the means proposed) by another observer, and with the same results, either identical or approximate. That question I have set at rest by causing certain stars to be observed by two persons. The position of extinction was not absolutely identical for both observers for the same star; but the wedge-interval between the positions of extinction for the two observers of the same star was practically the same; and this is all that is necessary, and all that can be expected in any photometric experiments, whether *nudis oculis* or with apparatus.

As an example, eight stars were observed by the two assistants, Mr. Plummer and Mr. Jenkins—the latter being comparatively new to the work—and the following are the results. It ought, however, to be premised that from the very nature of the observations there can be no previous bias on the part of the observer as to the precise position of extinction by the wedge.

No.	Star's Designation.	Observed Magnitude by P.	Observed Magnitude by J.	P.–J.
1	Lalande 33612 ...	6·05	6·08	–0·03
2	Groombridge 2530	6·10	6·02	+0·08
3	Groombridge 2533	5·92	5·77	+0·15
4	Groombridge 2538	6·03	6·16	–0·13
5	Lalande 34049 ...	7·66	7·69	–0·03
6	Lalande 34064 ...	6·84	6·90	–0·06
7	μ Lyræ	5·48	5·58	–0·10
8	W. B. xviii – 794	5·74	5·71	+0·03

The case now exhibited is the mean of five readings only; but the result, so far as it goes, shows that the two observers may possibly have a tendency to differ in their measures of light by one hundredth of a magnitude.

I have also had a further opportunity of comparing the results of three measurements of thirty out of the fifty stars referred to above. In my own opinion, they establish the exactitude of the method. As to its facility, it may be stated that during the very fine evening of the 17th inst. twenty stars were measured, each of them five times; but it would probably be better, and in the end more economical, to confine the work to about fifteen.

With regard to the homogeneity of the wedge, that element is sufficiently determined by the fact that the value of the constant κ remains sensibly persistent for all parts of the wedge; moreover, the observer's eye would necessarily detect any sensible inequality in its absorbing power, in the course of its continuous motion over the star in the focus of the eye-lens. As to what star or stars should be chosen for a standard, that is a matter to be determined hereafter; for my own purposes, I selected κ *Lyræ*, as a mere matter of convenience, for comparison with stars situated in its neighbourhood.

The practice of this Observatory will be to observe a set of stars on one fine night, taking for each the mean of five readings of the wedge. On the next fine night to repeat this same work twice, at an interval of about an hour; observing the standard star at least three times during the evening; and finally adopting the mean of the three sets as the magnitude of the star at the epoch of observation. Some months after it will be prudent to re-examine the whole with one set of five readings, by which process it may be expected that any variability in the stars will be indicated. As to an artificial standard of light, at present none seems to have been attained; it may be too much to say none is attainable. I subjoin a table of the thirty stars whose magnitudes have as yet been compared; the average deviation from the mean results is, so far, 0·08 magnitude.

TABLE VI.

Concluded Relative Magnitudes of Stars in the Constellation Lyra.

(Photometrically determined.)

Current No.	Star's Designation.	Observed Magnitude. 1	2	3	Mean Mag.	Average Deviation.	Magnitude in Argelander.	Heis.	Houzeau.
1	Lalande 33612	6·08	6·05	5·97	6·03	0·04	5·8	6	
2	Groombridge 2530	6·27	6·10	5·90	6·09	0·13	6·0	6	6
3	Groombridge 2533	5·96	5·92	5·90	5·93	0·02	5·5	5–6	6
4	Groombridge 2538	6·10	6·03	5·72	5·95	0·15	6·0	6	6–7
5	κ				4·7 adopted		4·7		

Current No.	Star's Designation.	Observed Magnitude. 1	2	3	Mean Mag.	Average Deviation.	Argelander.	Magnitude in Heis.	Houzeau.
6	Lalande 34049 ...	7·64	7·48	7·66	7·59	0·08	7·7	6–7	
7	Lalande 34064 ...	6·90	6·65	6·84	6·80	0·09	7·0		
8	μ Lyræ	5·31	5·48	5·34	5·38	0·07	5·1	5	5
9	Lalande 34132 ...	5·98	5·76	5·70	5·81	0·11	6·1	6–5	
10	W. B. xviii–794...	5·84	5·74	5·70	5·76	0·05	5·5	6–5	6
11	W. B. xviii–894...	5·95	6·00	5·82	5·92	0·07	6·4	6	6–7
12	W. B. xviii–934...	5·61	5·50	5·46	5·52	0·06	5·8	6	6
13	α Lyræ	0·36	0·36	0 42	0·38	0·03	1	1	1
14	W. B. xviii–972...*	6·01	6·36				7·0	6–7	
15	Radcliffe 3995 ...	6·51	6·32	6·31	6·38	0·09	6·0	6–7	6–7
16	Groombridge 2623	6·33	6·39	6·29	6·34	0·04	6·5	6–7	
17	W.B. xviii–1038...	6·64	6·85	6·70	6·73	0·07	6·3	6–7	
18	Groombridge 2627	6·21	6·17	6·30	6·23	0·05	6·2	6–7	
19	W.B. xviii–1117...	6·50	6·39	6·62	6·50	0·08	7·0	6–7	6–7
20	Lalande 34853 ...	5 79	6·00	5·98	5·92	0·09	5·5	6	6
21	Piazzi xviii–172...	6·15	6·35	6·32	6·27	0·10	6·4	6–7	
22	ε Lyræ	4·48	4·47	4·41	4·45	0·03	4·3	4–5	4
23	5 Lyræ	4·72	4·75	5·07	4·85	0·15	4·6	5–4	
24	W. B. xviii–1218	5·07	5·09	5·01	5·06	0·03	4·9	5	
25	Groombridge 2664	5·77	5·74	5·79	5·77	0·02	6·0	6	6–7
26	Lalande 35045 ...	6·07	6·01	5·92	6·00	0·05	6·0	6	
27	ν Lyræ	5·44	5·50	5·56	5·50	0·04	5·5	6–5	6
28	W. B. xviii–1402	6·61	6·43	6·36	6·47	0·10	6·5	6–7	6–7
29	W. B. xviii–1460	5·93	6·05	6·11	6·03	0·07	6·5	6	
30	W. B. xviii–1489	5·90	5·71	5·79	5·80	0·07	6·2	6–7	6

My present intention is to persevere in this research for some time to come, as being one which offers the promise of interesting results in many directions, and has been too long a desideratum in stellar astronomy. I propose, in particular, on the same principles and method, to systematically scrutinise the relative brilliancy at different parts of the Sun; employing for this purpose the De La Rue Reflector of 13 inches aperture, and provided with a Herschelian Prism in lieu of the smaller metallic plane mirror. Such observations, if continued long enough, may disclose important facts.

* This star was considered to be too near the horizon for accurate comparison at the time.